

Multinomial Probit and Logit Models

Conditional Logit Model

Mixed Logit Model

Examples

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Multinomial choice model example

- Data set for all examples comes from Herriges and Kling (1999) and Cameron and Trivedi (2005).
- We want to study how income affects the fishing choice of individuals.
- The multinomial dependent variable has 4 categories/alternatives: beach, pier, private, and charter boat.
- Independent variable is income. It is alternative invariant.
- Data are in a wide form, with one row for every individual.

Fishing mode	Codes for alternatives	Percent frequency
Beach fishing	1	11%
Pier fishing	2	15%
Private boat fishing	3	35%
Charter boat fishing	4	38%

- There will be 3 sets of coefficients for income (one set is normalized to zero – the reference/base category).
- There will be 4 sets of marginal effects for income (normalization of coefficients does not matter).

Multinomial logit coefficients (with coefficients for charter boat fishing normalized to zero)

	Beach	Pier	Private boat	Charter boat
Income	0.03	-0.11*	0.12*	0
Intercept	-1.34*	-0.53*	-0.60*	0

- Coefficient interpretation: in comparison to charter boat fishing, higher income is associated with a lower likelihood of pier fishing and a higher likelihood of private boat fishing.

Multinomial logit coefficients (with coefficients for pier fishing normalized to zero)

	Beach	Pier	Private boat	Charter boat
Income	0.14*	0	0.23*	0.11*
Intercept	-0.81*	0	-0.08	0.53*

- Coefficient interpretation: in comparison to pier fishing, higher income is associated with higher likelihoods of beach, private boat, and charter boat fishing.

Marginal effects (they are the same regardless of whether alternative 4 or 2 is the base category)

	Beach	Pier	Private boat	Charter boat
Income	0.00008	-0.02*	0.03*	-0.01*

- Marginal effects interpretation: one unit increase in income (corresponding to a thousand dollars) is associated with pier fishing being 2% less likely, private fishing being 3% more likely, and charter fishing being 1% less likely. The marginal effects sum up to zero.

Conditional logit model example

We want to study how income and the price and catch rate of each alternative affects the fishing choice of individuals.

- The dependent variable has 4 categories/alternatives: beach, pier, private, and charter boat.
- The independent variables are price and catch rate (alternative specific) and income (alternative variant).
- Data are in a long form, with 4 rows (alternatives) for each individual.
- There will be 3 sets of coefficients (one set is normalized to zero – the reference/base category) for the alternative-invariant regressors (income).
- There will be one set of coefficients for the alternative-specific regressors (price and catch rate).
- There will be 4 sets of marginal effects (normalization of coefficients does not matter) for all regressors.

Conditional logit coefficients (with coefficients for charter boat fishing normalized to zero)

	Beach	Pier	Private boat	Charter boat
Income	0.03	-0.09	0.12*	0
Intercept	-1.69*	-0.92*	-1.16*	0
Price	-0.03*			
Catch rate	0.36*			

- Coefficient interpretation for alternative-invariant regressors: in comparison to charter boat fishing, higher income is associated with a higher likelihood of private boat fishing.
- Coefficient interpretation for alternative-specific regressors: when the price of an alternative increases, this alternative is less likely to be chosen; when the catch rate of an alternative increases, this alternative is more likely to be chosen.
- Note that the coefficients on income in the conditional logit model are similar to the ones in the multinomial logit model.

Conditional logit coefficients (with coefficients for pier fishing normalized to zero)

	Beach	Pier	Private boat	Charter boat
Income	0.13*	0	0.22*	0.09*
Intercept	-0.78*	0	-0.25	0.91*
Price	-0.03*			
Catch rate	0.36*			

- Coefficient interpretation for alternative-invariant regressors: in comparison to pier fishing, higher income is associated with higher likelihoods of beach, private boat, and charter boat fishing.
- Coefficient interpretation for alternative-specific regressors: when the price of an alternative increases, this alternative is less likely to be chosen; when the catch rate of an alternative increases, this alternative is more likely to be chosen.
- Note that the coefficients on income in the conditional logit model are very similar to the ones in the multinomial logit model.
- Note that the coefficients on the alternative-specific regressors are the same, when different categories are selected as base category.

Marginal effects (they are the same regardless of whether alternative 4 or 2 is the base category)

	Beach	Pier	Private boat	Charter boat
Income	-0.0007	-0.010*	0.032*	-0.022*
Price Beach	-0.0013*	0.00009*	0.0006*	0.0006*
Price Pier	0.00009*	-0.0016*	0.0007*	0.0008*
Price Private	0.0006*	0.0007*	-0.0061*	0.0049*
Price Charter	0.0006*	0.0008*	0.0049*	-0.0062*
Catch Rate Beach	0.0178*	-0.0012*	-0.0079*	-0.0087*
Catch Rate Pier	-0.0012*	0.022*	-0.01*	-0.011*
Catch Rate Private	-0.0079*	-0.01*	0.087*	-0.069*
Catch Rate Charter	-0.0087*	-0.011*	-0.069*	0.089*

- Marginal effects interpretation for alternative-invariant regressors: one unit increase in income (corresponding to a thousand dollars) is associated with pier fishing being 1% less likely, private fishing being 3% more likely, and charter fishing being 2% less likely.
- Marginal effects interpretation for alternative-specific regressors: one unit increase in the price of beach fishing is associated with beach fishing being 0.13% less likely, pier fishing being 0.009% more likely, private boat fishing being 0.06% more likely, and charter boat fishing being 0.06% more likely.

- Note that when the price of an alternative increases, this alternative is less likely to be chosen, and other alternatives are more likely to be chosen.
- The marginal effects sum up to zero for both the alternative-invariant and alternative-specific variables.

Mixed logit model example

- We want to study the price of each alternative affects the fishing choice of individuals, when there is a heterogeneity across individuals in the effect of price.
- The dependent variable has 3 categories/alternatives: beach, pier, and private.
- The independent variables are catch rate and price. They are alternative specific. Also, we will include price and standard deviation of price in the model and dummy variables for two of the three alternatives: beach and private.
- Note that the data are in a long form, 3 rows (alternatives) for each observation.

	Mixed logit model coefficients
Catch rate	0.78
Dummy if beach is chosen	-0.77*
Dummy if private is chosen	-0.21
Dummy if beach is chosen * income	0.12*
Dummy if private is chosen * income	0.17*
Price	-0.11*
Sd (price)	0.06*

- Coefficient interpretation: if the beach alternative is chosen, consumers are less likely to select other alternatives; if the private boat alternative is chosen, consumers are indifferent about selecting other alternatives.
- Coefficient on price: when the price of an alternative increases, consumers are less likely to choose it.
- Coefficient on standard deviation in price: there is a considerable variation/heterogeneity across consumers in the effect of price.